

CLAIMS

What is claimed is:

- 1 1. An apparatus comprising:
2 an integrate circuit (IC) having
3 an operational circuit to operate at a first frequency, and
4 a proxy circuit to output a periodic signal at a second frequency
5 reflective of a potential of the first frequency; and
6 a voltage regulator controller coupled to the proxy circuit to receive the
7 periodic signal, and conditionally regulate voltage applied to the IC, based at
8 least in part on the second frequency.
- 1 2. The apparatus of claim 1, wherein at least a portion of the voltage regulator
2 controller is part of the IC.
- 1 3. The apparatus of claim 1, wherein the voltage regulator is part of the IC,
2 and the apparatus is the IC.
- 1 4. The apparatus of claim 1, wherein the proxy circuit comprises a ring
2 oscillator.
- 1 5. The apparatus of claim 1, wherein the voltage regulator controller
2 comprises a monitor coupled to the proxy circuit to receive the periodic signal,
3 determine and output a difference signal indicative of an amount of difference
4 between the second frequency and a target of the second frequency.
- 1 6. The apparatus of claim 5, wherein

2 the apparatus further comprises a first storage to store the target of the
3 second frequency; and
4 the monitor comprises
5 a first counter coupled to the proxy circuit to receive a first derived
6 version of the periodic signal for a period of time, determine the
7 second frequency based at least in part on the first derived version
8 of the periodic signal received during the period of time, and output
9 a first count value, indicative of the determined second frequency
10 for the period; and
11 a register coupled to the first counter to store the first count value, and
12 output the stored first count value as the determined second
13 frequency; and
14 a comparator coupled to the register and the storage to receive the
15 determined second frequency and the target of the second
16 frequency, and to generate and output the difference signal.
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1 7. The apparatus of claim 6, wherein the monitor further comprises
2 a divider coupled to the proxy circuit to receive the periodic signal and to
3 generate a second derived version of the periodic signal; and
4 a synchronizer coupled to the divider and the first counter to receive the
5 second derived version of the periodic signal and a clock signal, time adjust the
6 second derived version of the periodic signal to form said first derived version of
7 the periodic signal, and to provide the first derived version of the periodic signal
8 to the first counter.

1 8. The apparatus of claim 7, wherein the monitor further comprises a second
2 counter to receive the clock signal, and outputs a third count value for the first
3 counter and the register to control their operations.
4

1 9. The apparatus of claim 6, wherein the apparatus further comprises a
2 second storage to store an adjustment to the target of the second frequency, and
3 the monitor further bases its output of the difference signal on the adjustment to
4 the target of the second frequency.
5

1 10. The apparatus of claim 6, wherein the apparatus further comprises a
2 second storage to store an upward adjustment to the target of the second
3 frequency, and third storage to store a downward adjustment to the target of the
4 second frequency, and the voltage regulator controller further bases its output of
5 the difference signal on the upward adjustment as well as the downward
6 adjustment to the target of the second frequency.

1 11. The apparatus of claim 10, wherein the IC comprises a storage unit, and
2 at least one of the first, second, and third storages are different storage locations
3 of the storage unit.

1 12. The apparatus of claim 11, wherein the storage unit is a selected one of a
2 read-only-memory, and a random access memory.

1 13. The apparatus of claim 10, wherein at least a selected one of the first,
2 second, and third storages comprises one or more fuses.

1 14. The apparatus of claim 5, wherein the voltage regulator controller further
2 comprises a control block coupled to the monitor to receive the difference signal,
3 and generate one or more voltage application control signals to control voltage
4 applied to the IC, based at least in part on the received difference signal.

1 15. The apparatus of claim 14, wherein at least one of the voltage application
2 control signals controls a pulse width of a voltage signal outputted by a transistor
3 of a device to affect a current outputted by the device.

1 16. The apparatus of claim 14, wherein the control block comprises a
2 microcontroller.

1 17. In an apparatus including an integrated circuit (IC) having an operational
2 circuit designed to operate at a first frequency, a method comprising:
3 generating a periodic signal at a location on the IC near the operational
4 circuit, the periodic signal having a second frequency reflective of a potential of
5 the first frequency; and
6 monitoring the periodic signal to determine the second frequency;
7 generating a difference signal indicating an amount of difference between
8 the second frequency and a target of the second frequency; and
9 regulating voltage being applied to the IC, based at least in part on the
10 amount of difference.

1 18. The method of claim 17, wherein said generating further comprises
2 applying an adjustment to the target of the second frequency.

1 19. The method of claim 17, wherein said generating further comprises
2 applying an upward adjustment and a downward adjustment to the target of the
3 second frequency.

1 20. The method of claim 17, said regulating comprises generating one or
2 more control signals to control a number of electronic elements of a device to
3 affect voltage being applied to the IC, based at least in part on the amount of
4 difference.

1 21. A system comprising:
2 a first microprocessor having
3 a first operational circuit to operate at a first frequency; and
4 a first proxy circuit to output a first periodic signal at a second
5 frequency reflective of a potential of the first frequency;
6 a first voltage regulator controller, either coupled to, or integrated with the
7 first microprocessor, to receive the first periodic signal, and conditionally regulate
8 voltage applied to the first microprocessor, based at least in part on the second
9 frequency;
10 a bus coupled to the first microprocessor; and
11 a networking interface coupled to the bus.

1 22. The system of claim 21, wherein at least a portion of the first voltage
2 regulator controller is integrated with the first microprocessor.

1 23. The system of claim 21, wherein the first proxy circuit comprises a ring
2 oscillator.

1 24. The system of claim 21, wherein the first voltage regulator controller
2 comprises a monitor coupled to the first proxy circuit to receive the first periodic
3 signal, and determine and output a difference signal indicative of an amount of
4 difference between the second frequency and a target of the second frequency.

1 25. The system of claim 24, wherein
2 the system further comprises a first storage to store the target of the
3 second frequency; and
4 the monitor comprises
5 a first counter coupled to the first proxy circuit to receive a first derived
6 version of the first periodic signal for a period of time, determine the
7 second frequency based at least in part on the first derived version
8 of the first periodic signal received during the period of time, and
9 output a first count value, indicative of the determined second
10 frequency for the period,
11 a register coupled to the first counter to store the first count value, and
12 output the stored first count value as the determined second
13 frequency, and
14 a comparator coupled to the register and the storage to receive the
15 determined second frequency and the target of the second
16 frequency, and to generate and output the difference signal.

1 26. The system of claim 25, wherein the monitor further comprises a divider
2 coupled to the first proxy circuit to receive the first periodic signal, and generate a
3 second derived version of the first periodic signal, and a synchronizer coupled to
4 the divider and the first counter, to receive the second derived version of the first

5 periodic signal and a clock signal, to time adjust the second derived version of
6 the first periodic signal, and to provide the time adjusted second derived version
7 of the first periodic signal as the first derived version of the first periodic signal to
8 the first counter.

1 27. The system of claim 26, wherein the monitor further comprises a second
2 counter coupled to the first counter and the register to receive a clock signal and
3 to output a control signal to control the operations of the first counter and the
4 register.

1 28. The system of claim 25, wherein the system further comprises a second
2 storage to store an adjustment to the target of the second frequency, and the
3 monitor further bases its output of the difference signal on the adjustment to the
4 target of the second frequency.

1 29. The system of claim 25, wherein the system further comprises a second
2 storage to store an upward adjustment to the target of the second frequency, and
3 third storage to store a downward adjustment to the target of the second
4 frequency, and the monitor further bases its output of the difference signal on the
5 upward adjustment as well as the downward adjustment to the target of the
6 second frequency.

1 30. The system of claim 24, wherein the first voltage regulator controller
2 further comprises a control block coupled to the monitor to receive the difference
3 signal, and generate one or more control signals to control electronic elements of
4 a device to affect said voltage being applied to said IC, based at least in part on
5 the received difference signal.

1 31. The system of claim 21, wherein the system further comprises
2 a second microprocessor having
3 a second operational circuit to operate at a third frequency; and
4 a second proxy circuit to output a second periodic signal at a fourth
5 frequency reflective of a potential of the second frequency; and
6 a second voltage regulator controller, either coupled to, or integrated with
7 the second microprocessor, to receive the second periodic signal, and
8 conditionally regulate voltage applied to the second microprocessor, based at
9 least in part on the fourth frequency.

1 32. The system of claim 31, wherein the first proxy circuit and the first voltage
2 regulator of the first microprocessor, and the second proxy circuit and the second
3 voltage regulator of the second microprocessor are configured in a coordinated
4 manner.